

Identification of Residual Oil Zones (ROZs) in the Williston and Powder River Basins

Workshop on the CO₂ Storage and EOR Potential from Residual Oil Zones

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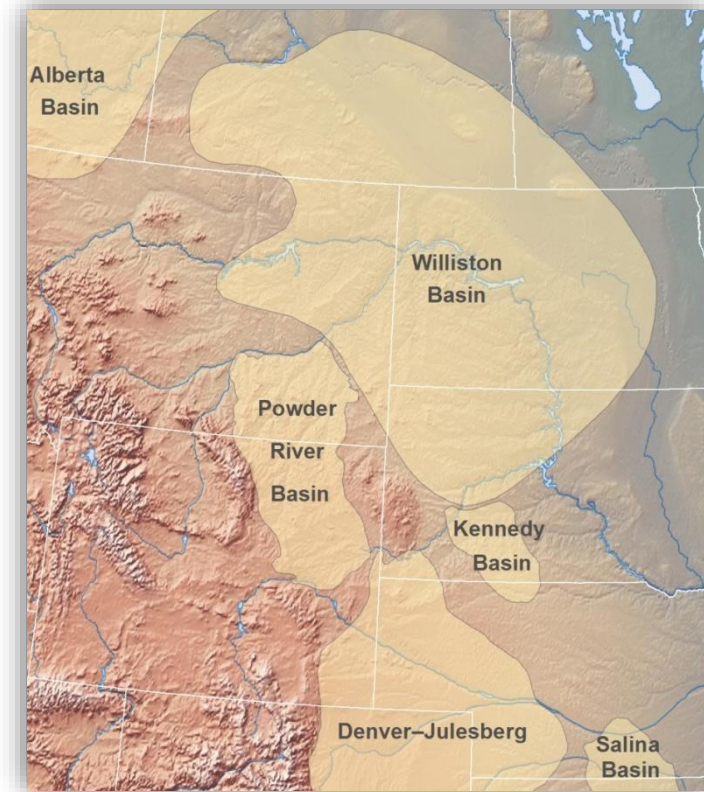


Energy & Environmental Research Center (EERC)

Project Overview: Goals and Objectives

Objectives:

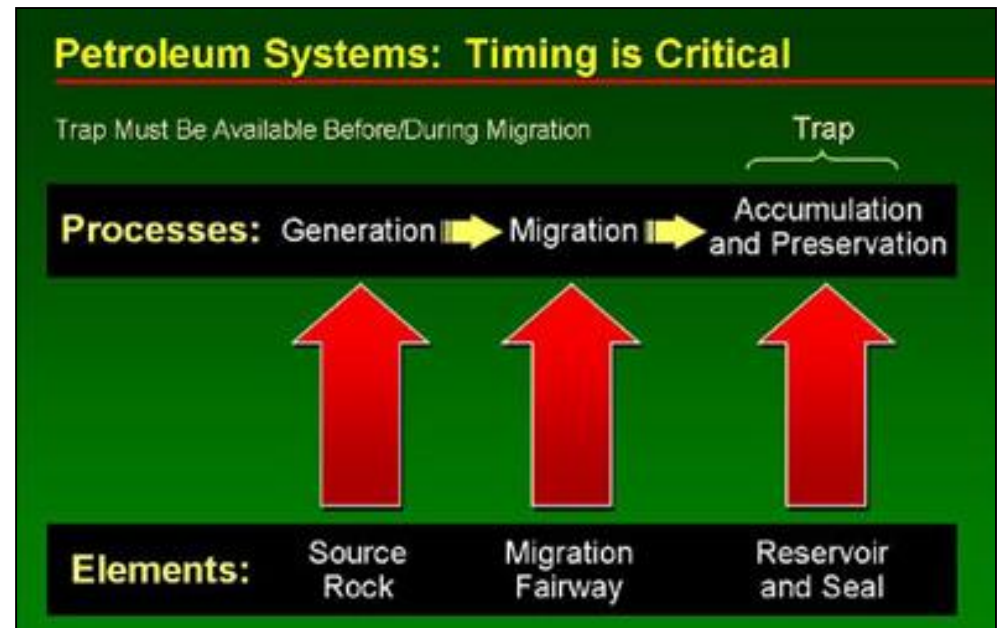
- Identify and characterize the presence and extent of potential ROZs in the Williston Basin (WB) and Powder River Basin (PRB).
- Estimate residual oil in place and CO₂ storage potential.
- Determine feasibility of CO₂ enhanced oil recovery (EOR) in identified ROZs.
- Develop repeatable methodology for sedimentary basins to be included in a best practices manual (BPM).



Basin Modeling

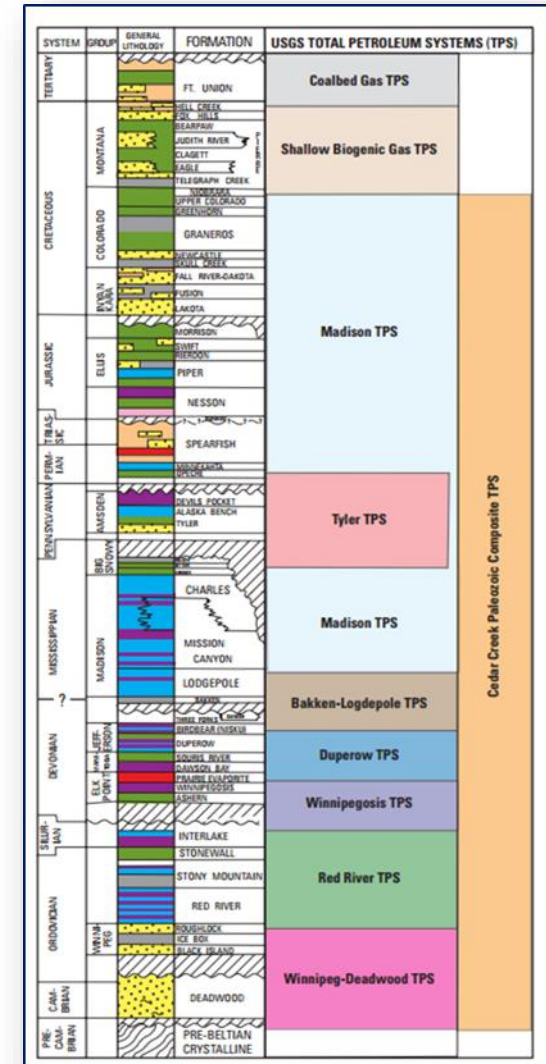
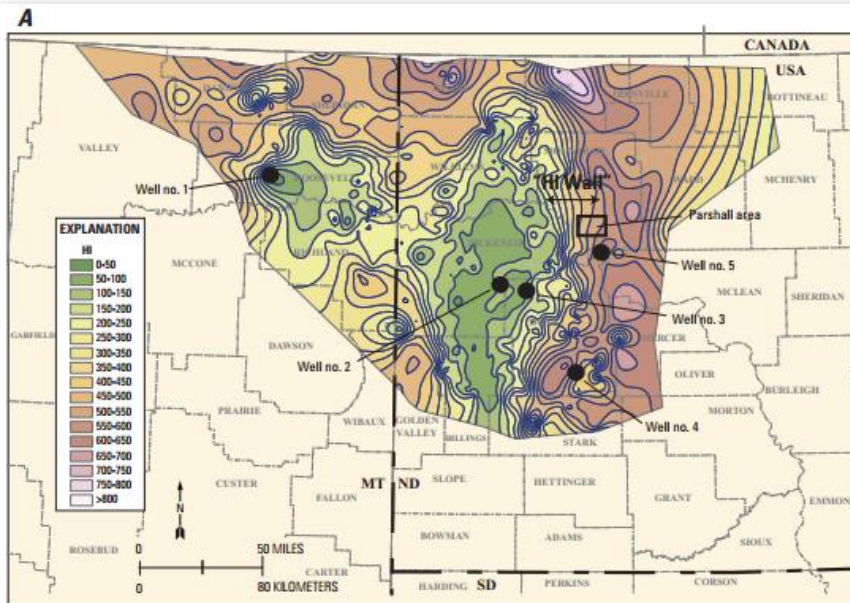
Provides a complete record of the evolution of a petroleum system, including:

- Deposition and erosion.
- Pressure and compaction.
- Heat flow analysis.
- Petroleum generation.
- Fluid pressure, volume, temperature analysis.
- Reservoir volumetrics.
- Structural evolution.
- Generation, migration, and accumulation of hydrocarbons.



Approach

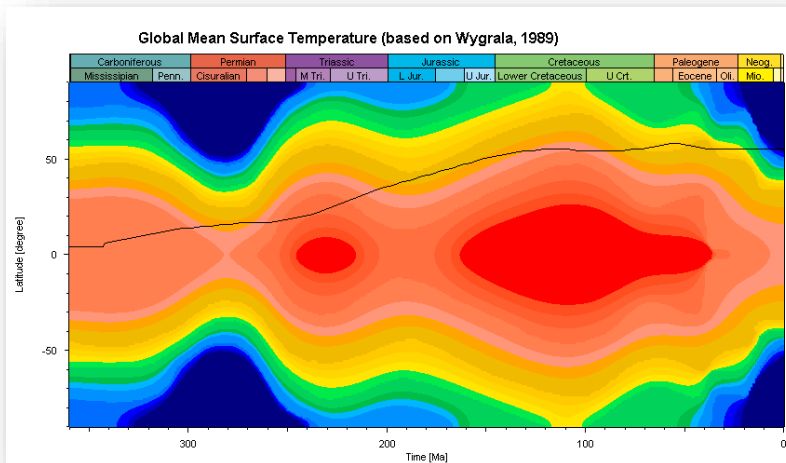
- Understand ROZs and previous work in basin modeling, both local and abroad.
- Translate geologic history of basins into an input for modeling.
- Gather data required for model construction.



1-D and 2-D Modeling

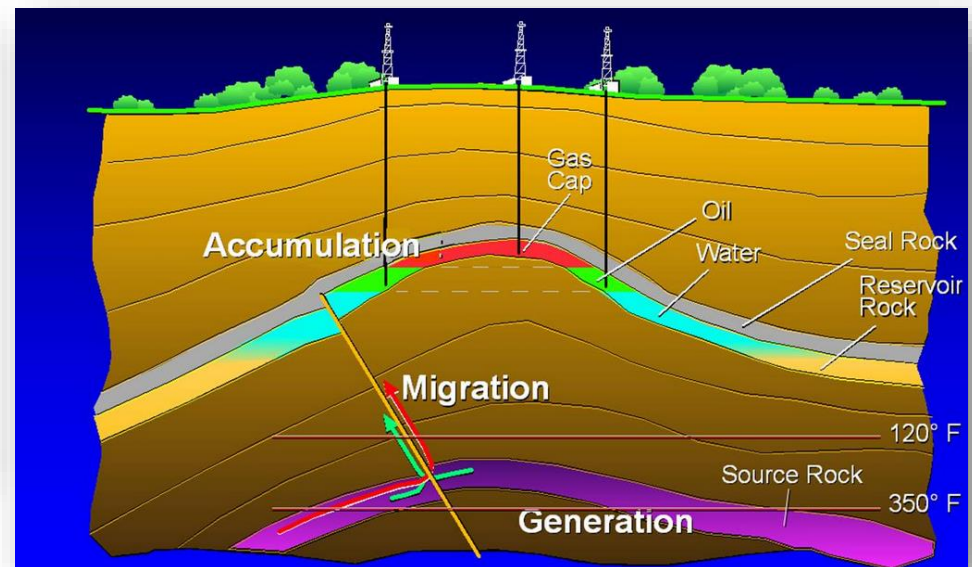
1-D Models

- Point location examination of:
 - Burial history.
 - Temperatures.
 - Boundary conditions.
 - Generation.



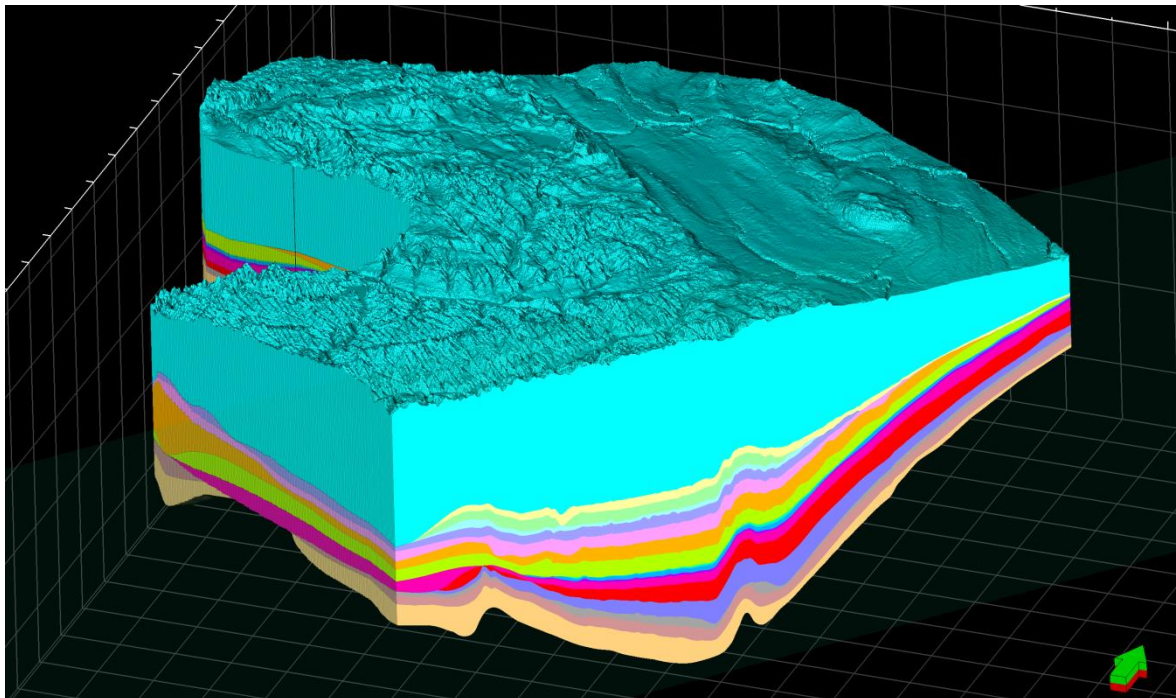
2-D Models

- Investigate generation and lateral migration.
- Faster simulation times than 3-D.



3-D Models

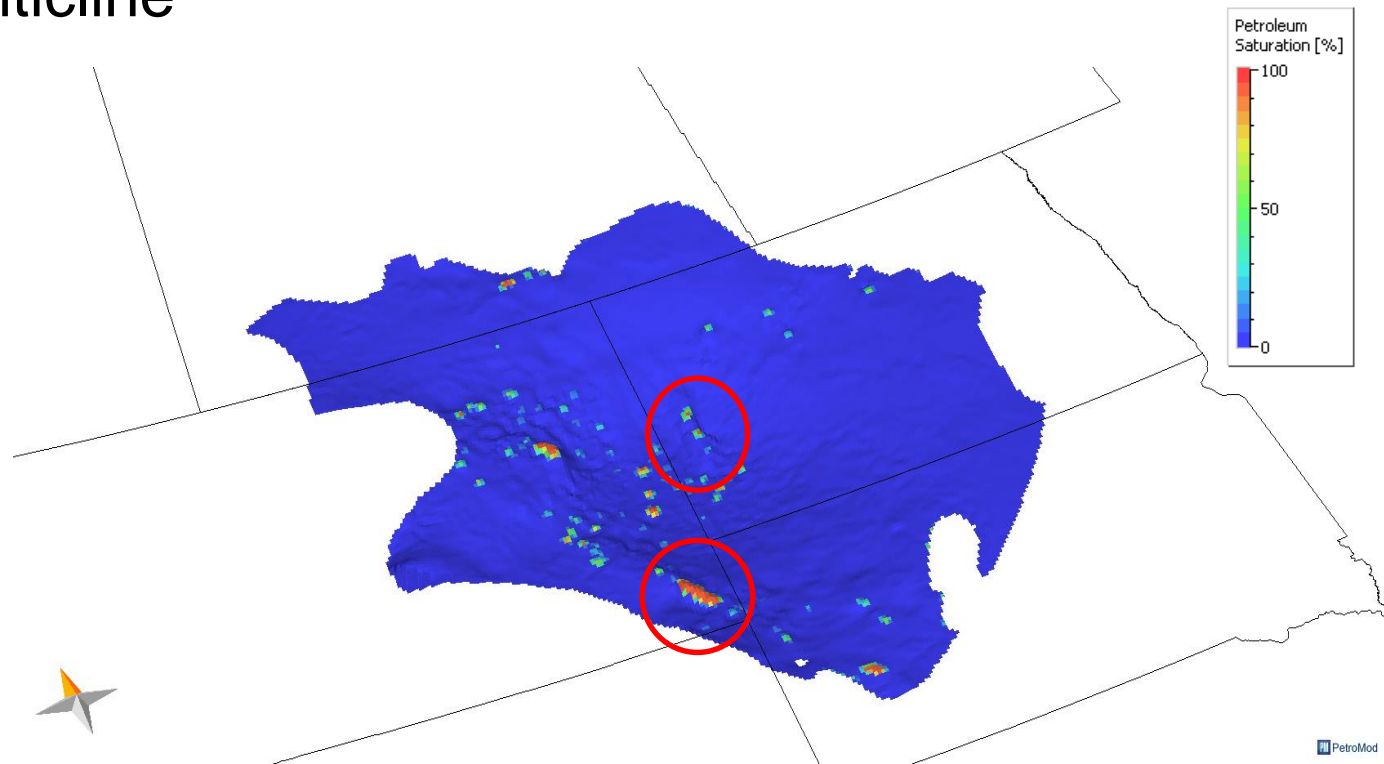
- Robust basin analysis that provides more detail than a simplified 2-D model.
- Structural models have been developed.
- Generation and migration calibration ongoing.



Williston Basin Structure Model
50x Vertical Exaggeration

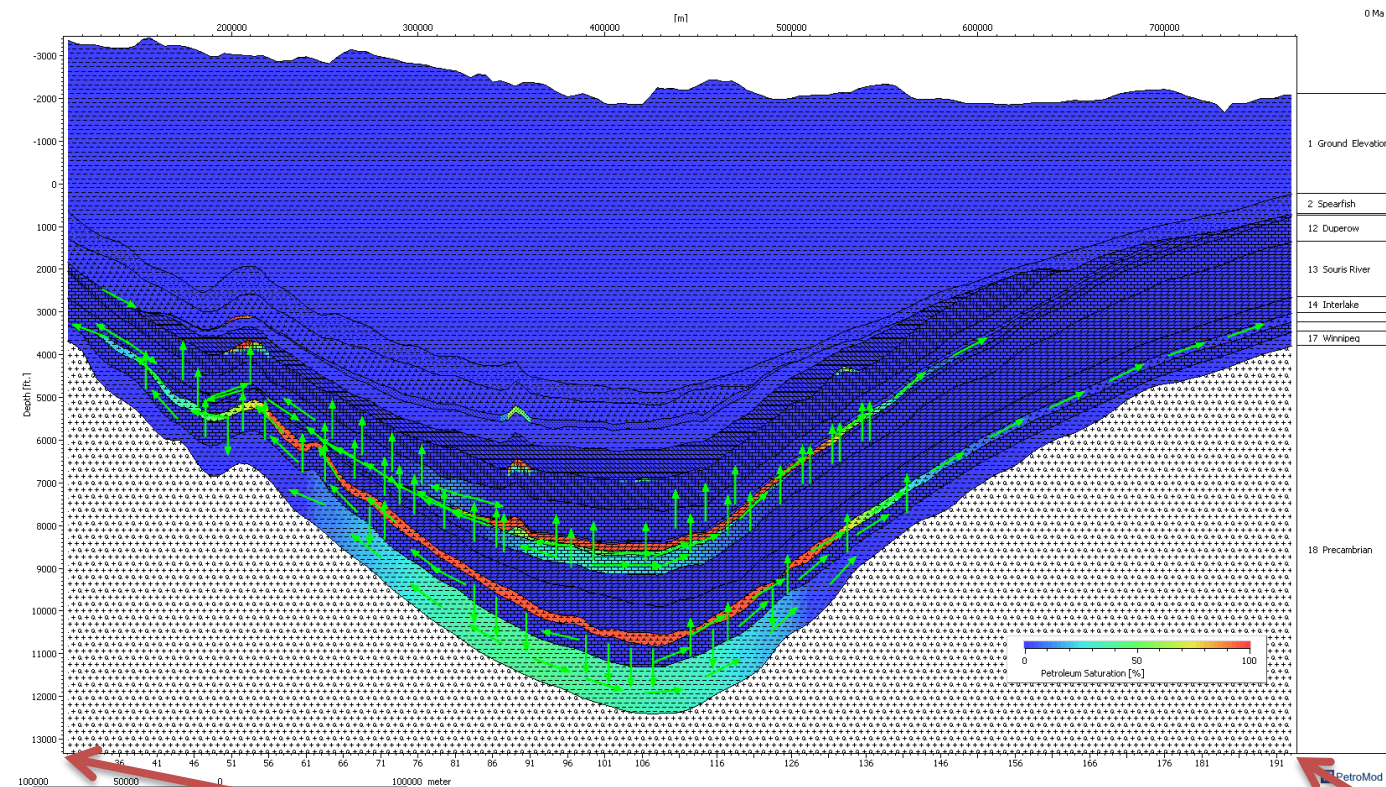
3-D Models

- Current models predict hydrocarbon accumulations that largely agree with known Mission Canyon pools.
 - Cedar Creek Anticline
 - Nesson Anticline

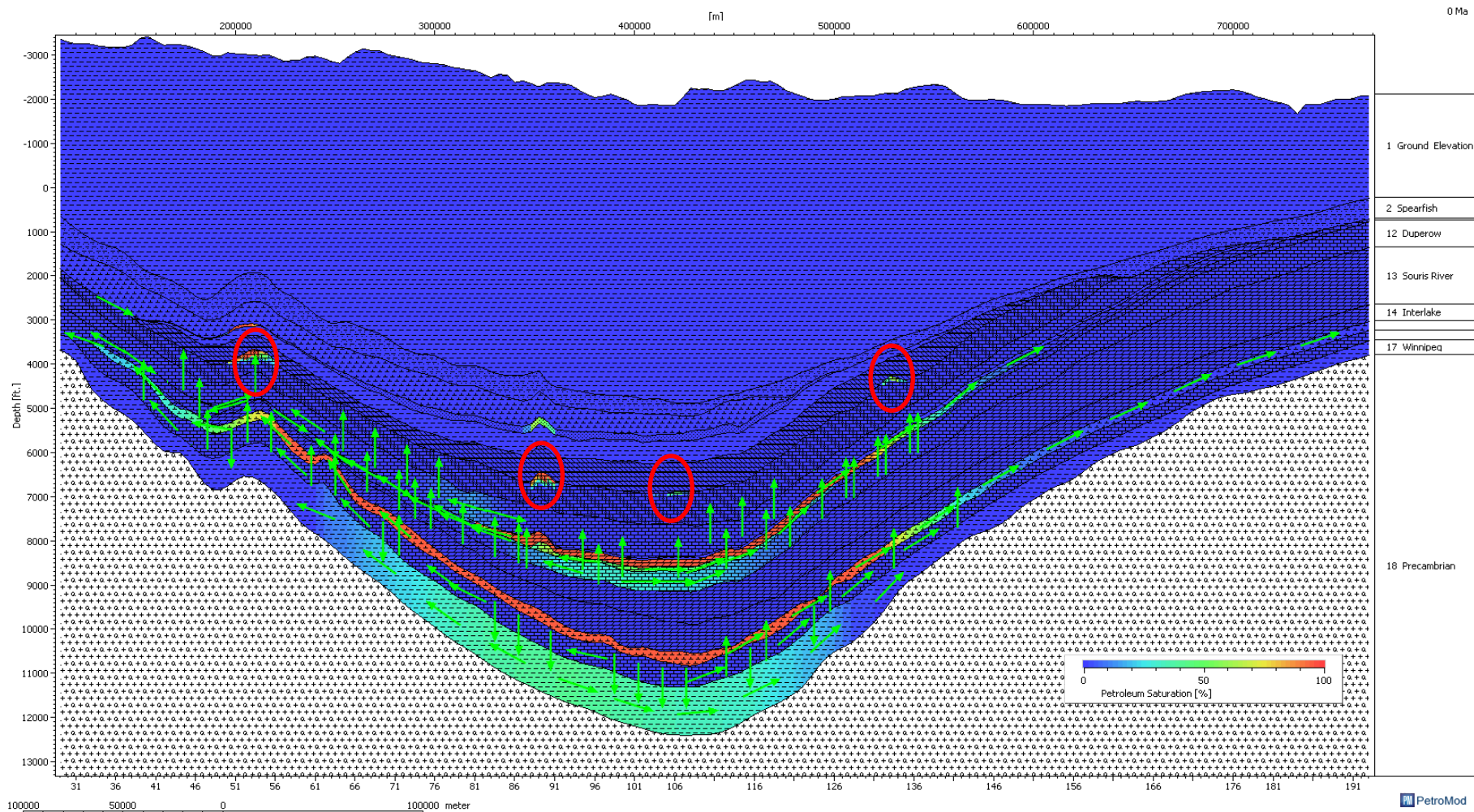


3-D Models

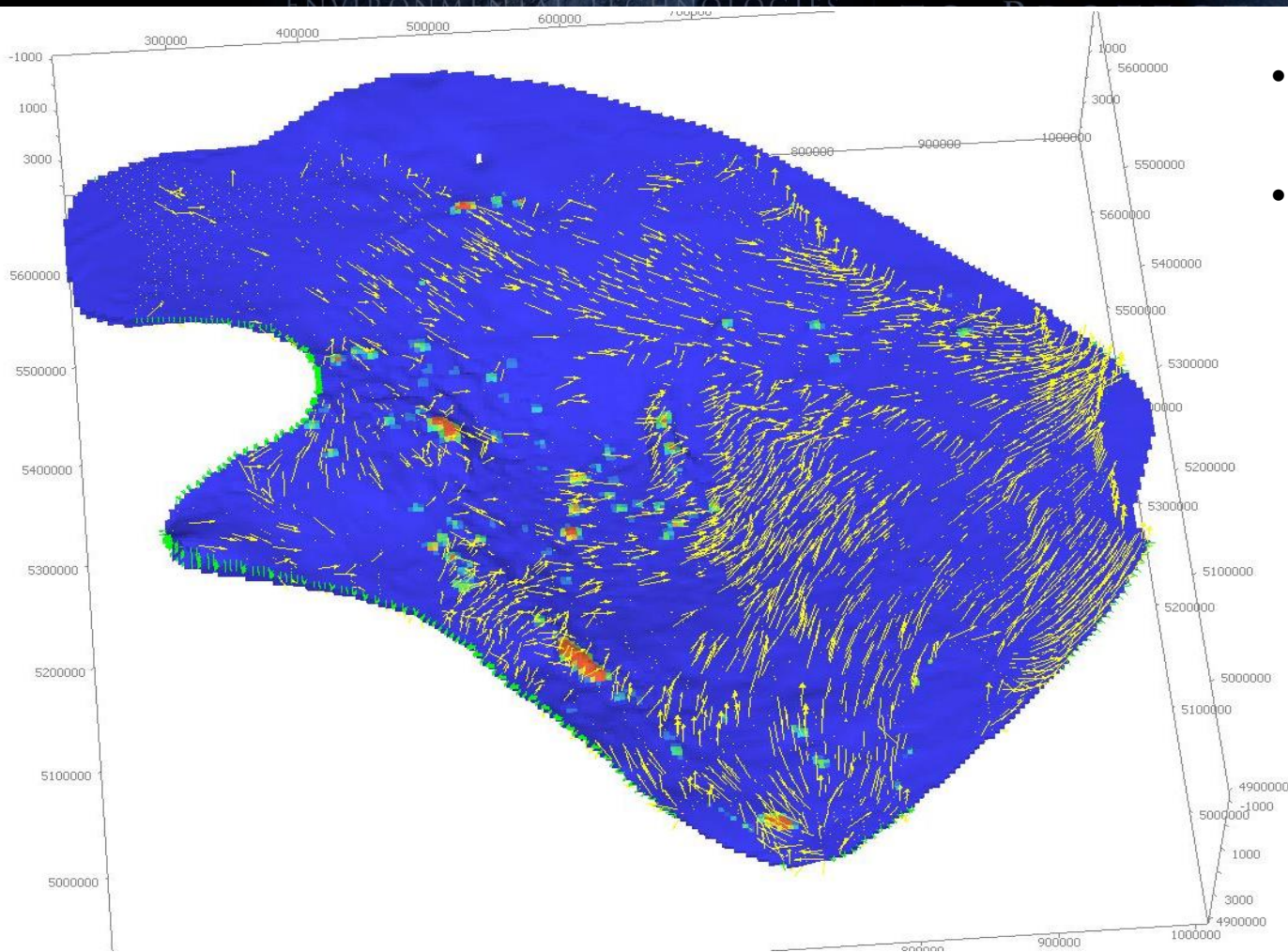
- Extracted 2-D models depict expulsion and migration throughout the Williston Basin.



3-D Models



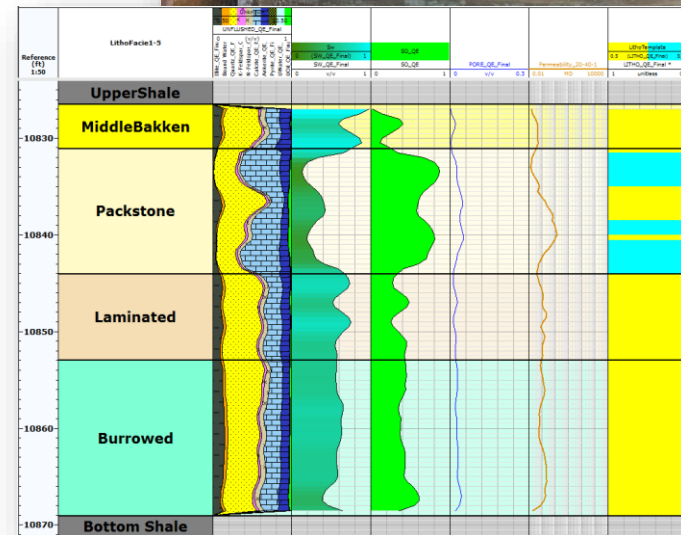
3-D Models



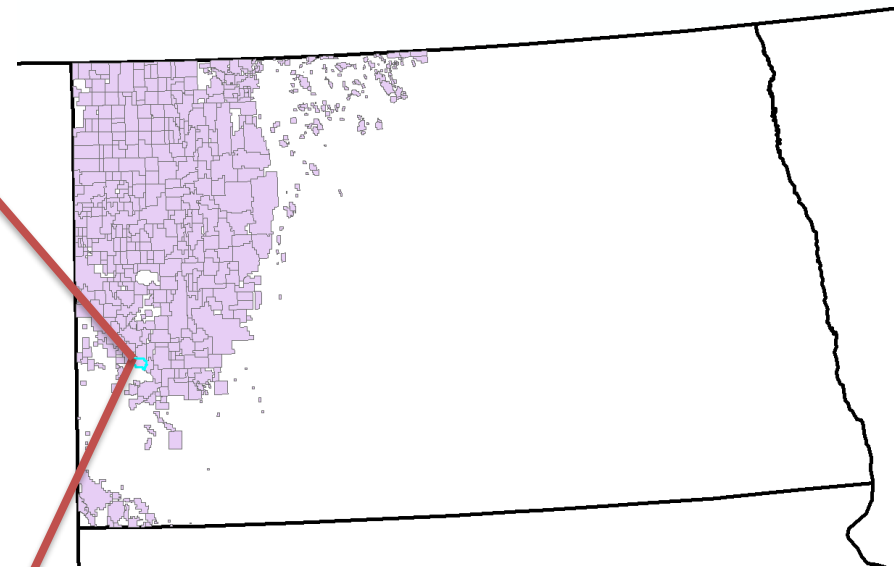
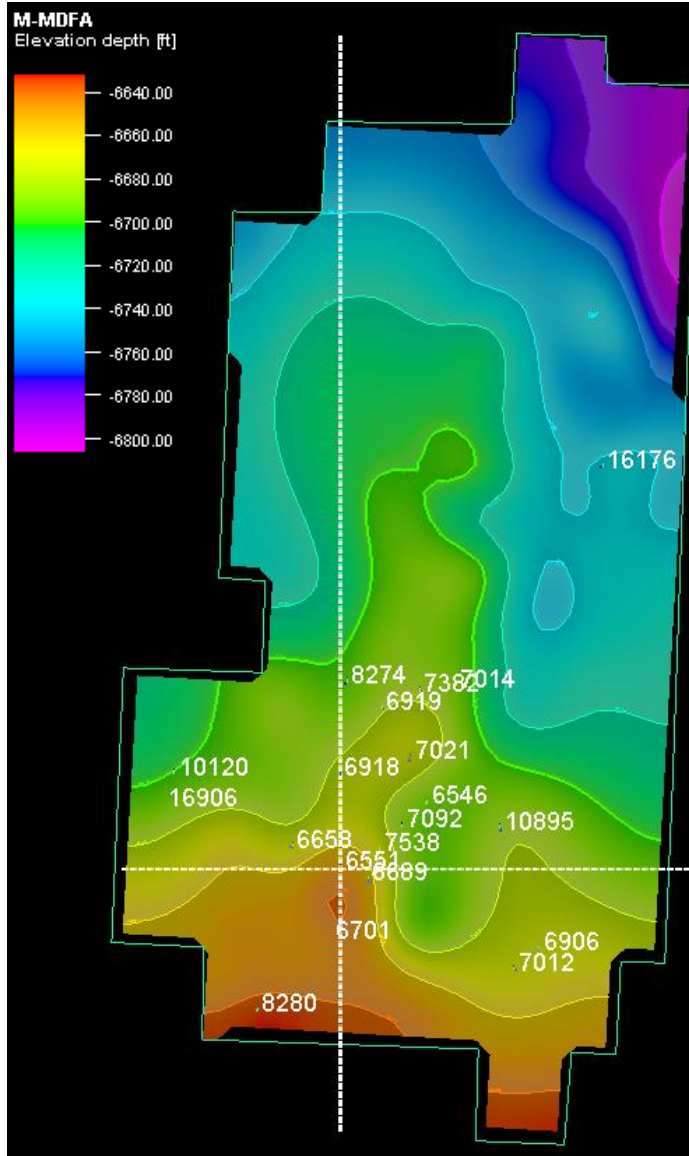
- Vectors depicting water movement.
- Modeling results support a majority of the water from the southwest moving around the basin, rather than through it.

Core Analysis

- Data from core will be used to support the modeling effort (e.g., calibration, validation).
- Multiple wells will be chosen based on literature review, modeling results, and core availability.



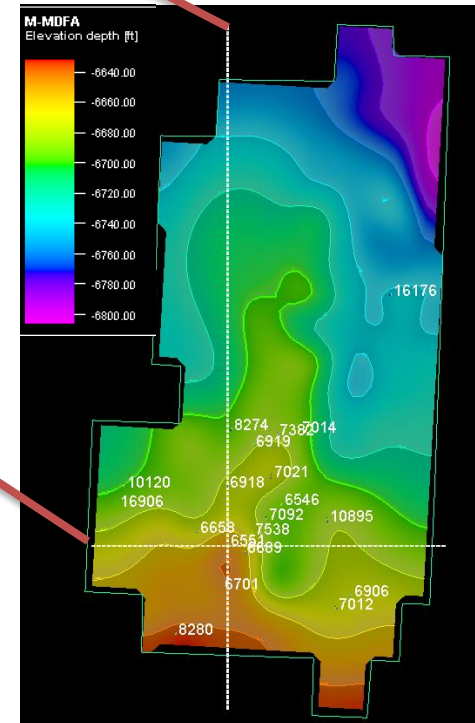
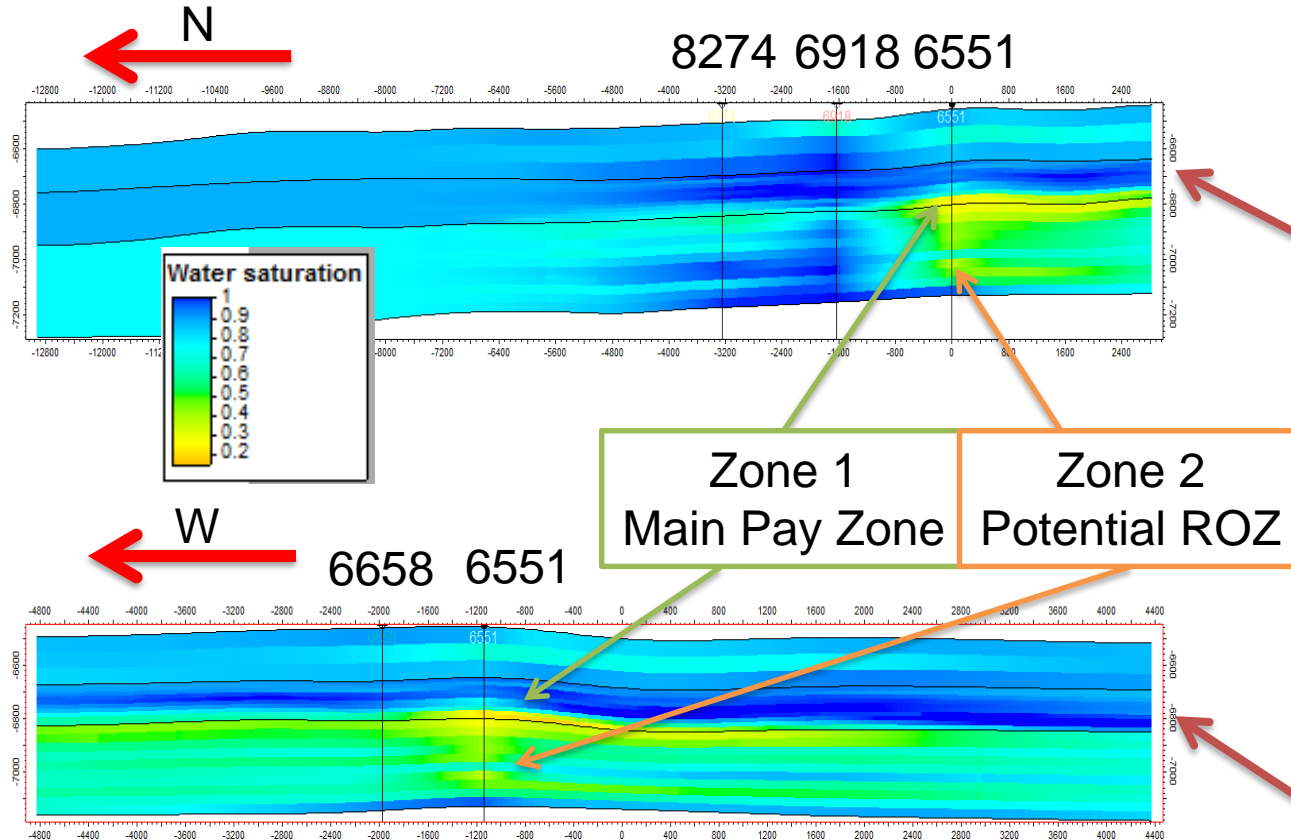
Petrophysical Approach



Petrophysical workflows analyzing oil and water saturations from existing logs in areas of known tilted oil–water contacts will support modeling efforts.

- Example: T.R. and Big Stick Fields in southwestern North Dakota.

Petrophysics



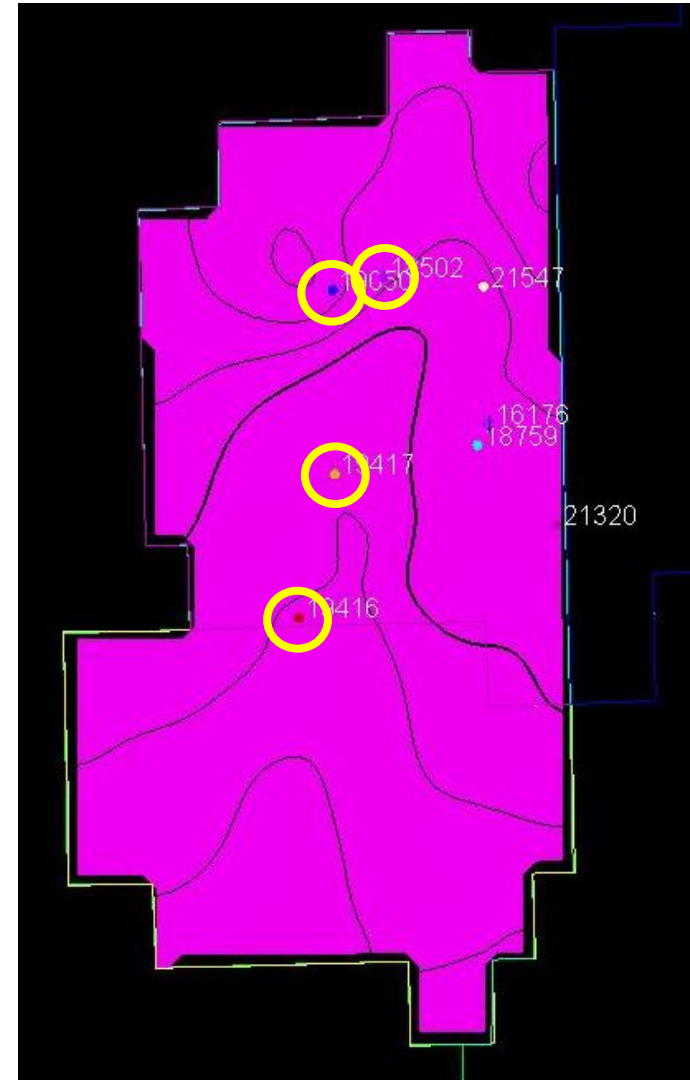
Field-scale models and petrophysical analyses will be used to validate and calibrate basin-scale models.

Pulsed Neutron Logs (PNLs)

PNLs will be collected near suspected ROZs to support and validate modeling and petrophysical analysis efforts.

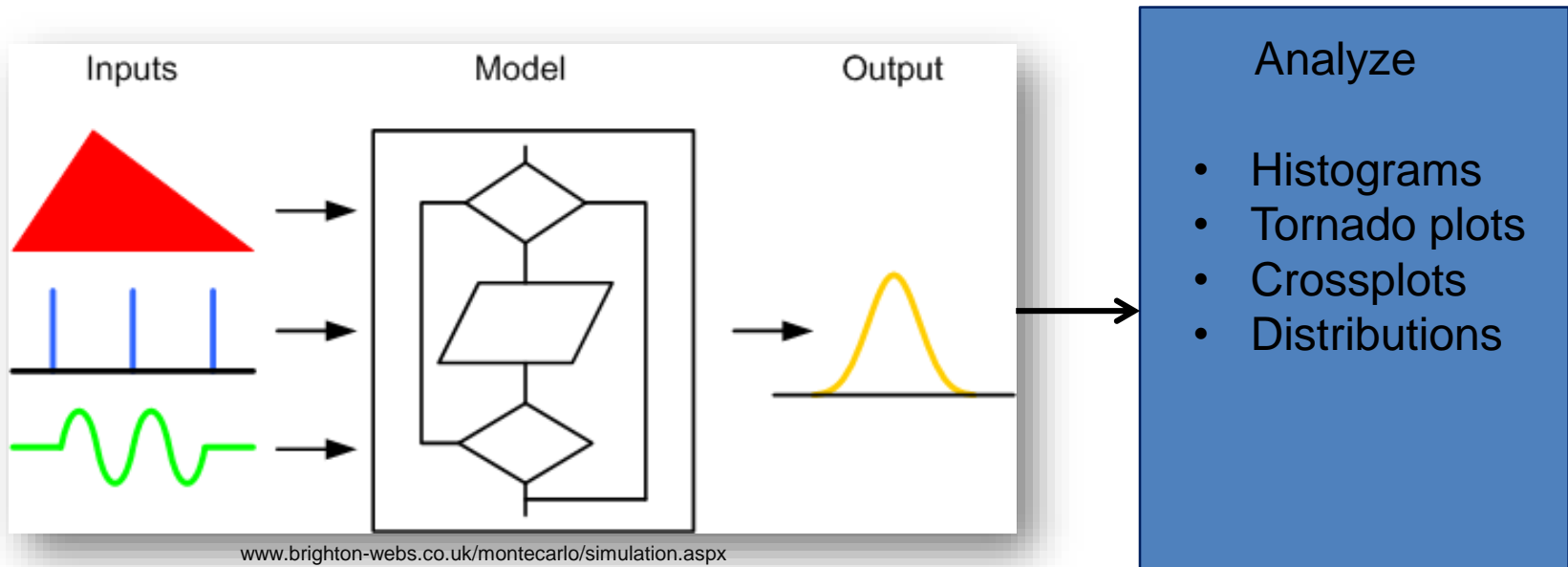
To choose potential locations for PNLs, several criteria must be met:

- Currently active well
- Wells penetrate through to the potential ROZ
- Completion specifications



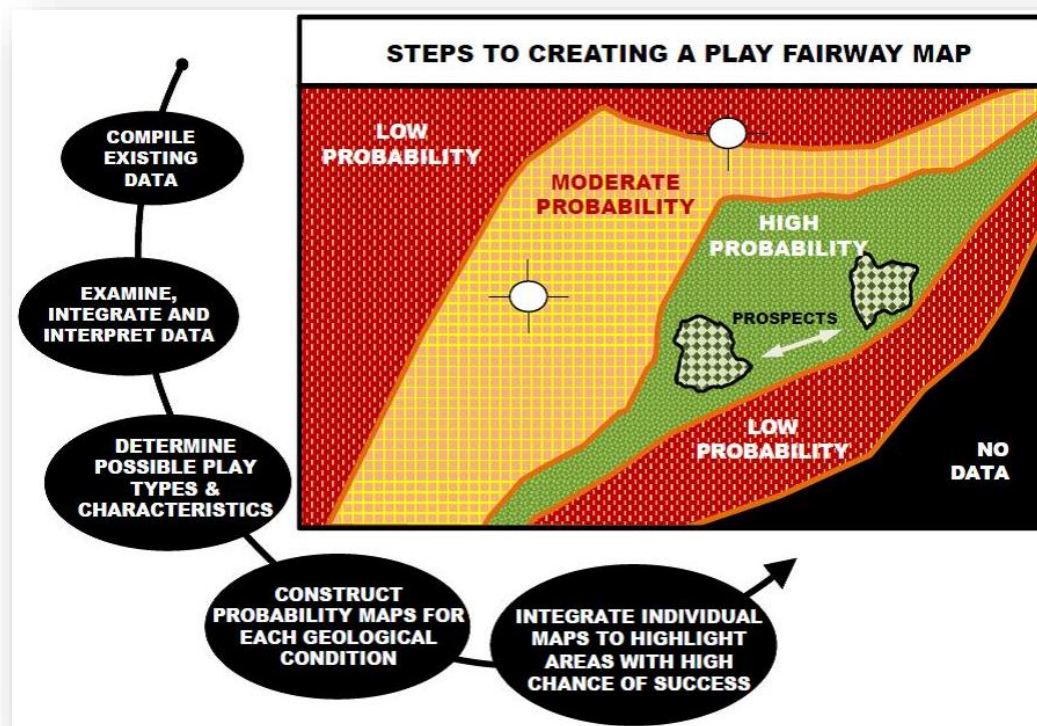
Risk Analysis

- Uncertainty analysis using Monte Carlo simulations will be performed to better understand the impact of key variables..
- Range of data for each variable will come from literature review database.
- Probabilities, confidence intervals, error bars, correlations, and calibration will be considered to find the best model fit.
- High-, mid-, and low-probability models will be used in fairway mapping.



Output – ROZ Fairway Mapping

- Create play fairway maps showing potential brownfield (existing fields) and greenfield (new fields) ROZs.
- Display high, mid-, and low probabilities.



Output – CO₂ EOR Feasibility Study

- Analyze potential ROZs to determine feasibility for enhanced recovery using CO₂.
- Use published ranges for recovery and utilization factors for conventional CO₂ EOR projects.
- Make high, mid-, and low estimates.



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